

frivol

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# Contents

<b>1</b>	<b>Class Index</b>	<b>1</b>
1.1	Class Hierarchy . . . . .	1
<b>2</b>	<b>Class Index</b>	<b>3</b>
2.1	Class List . . . . .	3
<b>3</b>	<b>Class Documentation</b>	<b>5</b>
3.1	frivol::fortune::Algorithm< PolicyT > Class Template Reference . . . . .	5
3.1.1	Detailed Description . . . . .	5
3.1.2	Constructor & Destructor Documentation . . . . .	5
3.1.2.1	Algorithm . . . . .	6
3.1.3	Member Function Documentation . . . . .	6
3.1.3.1	getSweepLineY . . . . .	6
3.2	frivol::fortune::Arc Struct Reference . . . . .	6
3.3	frivol::containers::Array< T > Class Template Reference . . . . .	6
3.3.1	Detailed Description . . . . .	7
3.3.2	Constructor & Destructor Documentation . . . . .	7
3.3.2.1	Array . . . . .	7
3.3.3	Member Function Documentation . . . . .	7
3.3.3.1	operator[] . . . . .	7
3.3.3.2	operator[] . . . . .	7
3.3.3.3	resize . . . . .	7
3.4	frivol::fortune::BeachLine< PolicyT > Class Template Reference . . . . .	8
3.4.1	Detailed Description . . . . .	8
3.4.2	Constructor & Destructor Documentation . . . . .	8
3.4.2.1	BeachLine . . . . .	8
3.4.3	Member Function Documentation . . . . .	9
3.4.3.1	getLeftArc . . . . .	9
3.4.3.2	getMaxArcCount . . . . .	9
3.4.3.3	getOriginSite . . . . .	9
3.4.3.4	getRightArc . . . . .	9
3.4.3.5	insertArc . . . . .	9

3.4.3.6	<a href="#">removeArc</a>	10
3.5	<a href="#">frivol::containers::priority_queues::DummyPriorityQueue&lt; PriorityT &gt; Class Template Reference</a>	10
3.6	<a href="#">frivol::containers::search_trees::DummySearchTree&lt; ElementT &gt; Class Template Reference</a>	10
3.7	<a href="#">frivol::GeometryTraits&lt; CoordT &gt; Struct Template Reference</a>	11
3.7.1	<a href="#">Detailed Description</a>	11
3.8	<a href="#">frivol::GeometryTraits&lt; double &gt; Struct Template Reference</a>	11
3.9	<a href="#">frivol::GeometryTraits&lt; float &gt; Struct Template Reference</a>	11
3.10	<a href="#">frivol::GeometryTraitsFloat&lt; CoordT &gt; Struct Template Reference</a>	12
3.10.1	<a href="#">Detailed Description</a>	12
3.11	<a href="#">frivol::GeometryTraitsImplementedConcept&lt; CoordT &gt; Class Template Reference</a>	12
3.11.1	<a href="#">Detailed Description</a>	12
3.12	<a href="#">frivol::Point&lt; CoordT &gt; Struct Template Reference</a>	13
3.12.1	<a href="#">Detailed Description</a>	13
3.12.2	<a href="#">Constructor &amp; Destructor Documentation</a>	13
3.12.2.1	<a href="#">Point</a>	14
3.13	<a href="#">frivol::Policy&lt; CoordT, EventPriorityQueueT, BeachLineSearchTreeT &gt; Struct Template Reference</a>	14
3.13.1	<a href="#">Detailed Description</a>	14
3.14	<a href="#">frivol::containers::PriorityQueueConcept&lt; X, PriorityT &gt; Class Template Reference</a>	14
3.14.1	<a href="#">Detailed Description</a>	14
3.15	<a href="#">frivol::containers::SearchTreeConcept&lt; X, ElementT &gt; Class Template Reference</a>	15
3.15.1	<a href="#">Detailed Description</a>	15
3.16	<a href="#">frivol::containers::Stack&lt; T &gt; Class Template Reference</a>	16
3.16.1	<a href="#">Detailed Description</a>	16
3.16.2	<a href="#">Member Function Documentation</a>	16
3.16.2.1	<a href="#">push</a>	16
3.16.2.2	<a href="#">top</a>	16

# Chapter 1

## Class Index

### 1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

frivol::fortune::Algorithm< PolicyT > . . . . .	5
frivol::fortune::Arc . . . . .	6
frivol::containers::Array< T > . . . . .	6
frivol::fortune::BeachLine< PolicyT > . . . . .	8
frivol::containers::priority_queues::DummyPriorityQueue< PriorityT > . . . . .	10
frivol::containers::search_trees::DummySearchTree< ElementT > . . . . .	10
frivol::GeometryTraits< CoordT > . . . . .	11
frivol::GeometryTraitsFloat< CoordT > . . . . .	12
frivol::GeometryTraitsFloat< double > . . . . .	12
frivol::GeometryTraits< double > . . . . .	11
frivol::GeometryTraitsFloat< float > . . . . .	12
frivol::GeometryTraits< float > . . . . .	11
frivol::GeometryTraitsImplementedConcept< CoordT > . . . . .	12
frivol::Point< CoordT > . . . . .	13
frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT > . . . . .	14
frivol::containers::PriorityQueueConcept< X, PriorityT > . . . . .	14
frivol::containers::SearchTreeConcept< X, ElementT > . . . . .	15
frivol::containers::Stack< T > . . . . .	16



## Chapter 2

# Class Index

### 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">frivol::fortune::Algorithm&lt; PolicyT &gt;</a>	5
<a href="#">frivol::fortune::Arc</a>	
Information of an arc in <a href="#">BeachLine</a>	6
<a href="#">frivol::containers::Array&lt; T &gt;</a>	6
<a href="#">frivol::fortune::BeachLine&lt; PolicyT &gt;</a>	8
<a href="#">frivol::containers::priority_queues::DummyPriorityQueue&lt; PriorityT &gt;</a>	
Simple implementation of <a href="#">PriorityQueueConcept</a>	10
<a href="#">frivol::containers::search_trees::DummySearchTree&lt; ElementT &gt;</a>	
Simple implementation of <a href="#">SearchTreeConcept</a> (a wrapper around <code>std::list</code> )	10
<a href="#">frivol::GeometryTraits&lt; CoordT &gt;</a>	11
<a href="#">frivol::GeometryTraits&lt; double &gt;</a>	11
<a href="#">frivol::GeometryTraits&lt; float &gt;</a>	11
<a href="#">frivol::GeometryTraitsFloat&lt; CoordT &gt;</a>	12
<a href="#">frivol::GeometryTraitsImplementedConcept&lt; CoordT &gt;</a>	12
<a href="#">frivol::Point&lt; CoordT &gt;</a>	13
<a href="#">frivol::Policy&lt; CoordT, EventPriorityQueueT, BeachLineSearchTreeT &gt;</a>	14
<a href="#">frivol::containers::PriorityQueueConcept&lt; X, PriorityT &gt;</a>	14
<a href="#">frivol::containers::SearchTreeConcept&lt; X, ElementT &gt;</a>	15
<a href="#">frivol::containers::Stack&lt; T &gt;</a>	16





## Chapter 3

# Class Documentation

### 3.1 frivol::fortune::Algorithm< PolicyT > Class Template Reference

```
#include <fortune.hpp>
```

#### Public Types

- typedef PolicyT::Coord **CoordT**
- typedef [Point](#)< CoordT > **PointT**

#### Public Member Functions

- [Algorithm](#) (const [containers::Array](#)< [PointT](#) > &sites)
- void [step](#) ()  
*Runs the algorithm one event handling forward.*
- CoordT [getSweepLineY](#) () const
- bool [isFinished](#) ()  
*Returns true if the algorithm has finished.*
- void [finish](#) ()  
*Steps the algorithm until the end.*
- int [getVoronoiVertexCount](#) () const  
*Returns the number of Voronoi vertices met in the algorithm.*

#### 3.1.1 Detailed Description

```
template<typename PolicyT = DefaultPolicy>class frivol::fortune::Algorithm< PolicyT >
```

State of Fortune's algorithm.

#### Template Parameters

<i>PolicyT</i>	The algorithm policy to use, instance of <a href="#">Policy</a> template.
----------------	---

#### 3.1.2 Constructor & Destructor Documentation

**3.1.2.1** `template<typename PolicyT> frivol::fortune::Algorithm< PolicyT>::Algorithm ( const containers::Array< PointT> & sites )`

Constructs algorithm state.

#### Parameters

<i>points</i>	Reference to the input set of sites. The object must exist throughout the existence of the <a href="#">Algorithm</a> .
---------------	--

### 3.1.3 Member Function Documentation

**3.1.3.1** `template<typename PolicyT> PolicyT::Coord frivol::fortune::Algorithm< PolicyT>::getSweepLineY ( ) const`

Returns the sweepline Y coordinate of last [step\(\)](#). Undefined return value if [step\(\)](#) has not been called yet.

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/fortune.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/fortune\_impl.hpp

## 3.2 frivol::fortune::Arc Struct Reference

Information of an arc in [BeachLine](#).

```
#include <beach_line.hpp>
```

#### Public Attributes

- Idx [site](#)  
*The index of the site from which the arc originates.*
- Idx [arc\\_id](#)  
*The ID of the arc.*

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach\_line.hpp

## 3.3 frivol::containers::Array< T> Class Template Reference

```
#include <array.hpp>
```

#### Public Member Functions

- [Array](#) (Idx size)
- Idx [getSize](#) () const  
*Returns the size of the array.*
- void [resize](#) (Idx size)
- const T & [operator\[\]](#) (Idx index) const
- T & [operator\[\]](#) (Idx index)

### 3.3.1 Detailed Description

```
template<typename T>class frivol::containers::Array< T >
```

Simple fixed-size array.

#### Template Parameters

<i>T</i>	The type of stored elements. Should be default constructible.
----------	---

### 3.3.2 Constructor & Destructor Documentation

3.3.2.1 `template<typename T > frivol::containers::Array< T >::Array ( Idx size )`

Creates an array with all elements default-constructed.

#### Parameters

<i>size</i>	The size of the array.
-------------	------------------------

### 3.3.3 Member Function Documentation

3.3.3.1 `template<typename T > const T & frivol::containers::Array< T >::operator[] ( Idx index ) const`

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

#### Exceptions

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

3.3.3.2 `template<typename T > T & frivol::containers::Array< T >::operator[] ( Idx index )`

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

#### Exceptions

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

3.3.3.3 `template<typename T > void frivol::containers::Array< T >::resize ( Idx size )`

Resizes the array to size. If size decreases the extra elements are removed. If size increases, the new elements are default-constructed. The operation may assign the current elements to a new place, and therefore pointers to the array may be invalidated.

## Parameters

<i>size</i>	The new size.
-------------	---------------

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/array.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/containers/array\_impl.hpp

### 3.4 frivol::fortune::BeachLine< PolicyT > Class Template Reference

```
#include <beach_line.hpp>
```

#### Public Types

- typedef PolicyT::Coord **CoordT**
- typedef [Point](#)< CoordT > **PointT**

#### Public Member Functions

- [BeachLine](#) (const [containers::Array](#)< [PointT](#) > &sites, Idx max\_arcs)
- Idx [getMaxArcCount](#) () const
- std::pair< Idx, Idx > [insertArc](#) (Idx site, const CoordT &sweep\_line\_y)
- void [removeArc](#) (Idx arc\_id)
- Idx [getLeftArc](#) (Idx arc\_id) const
- Idx [getRightArc](#) (Idx arc\_id) const
- Idx [getOriginSite](#) (Idx arc\_id) const

#### 3.4.1 Detailed Description

```
template<typename PolicyT>class frivol::fortune::BeachLine< PolicyT >
```

The advancing sweepline of Fortune's algorithm. Consists of parabolic arcs that are defined to be the curves that have equal distances from an input site and from the sweepline. Adjacent arcs are separated by their intersection points called breakpoints.

The arcs of the beach line are identified by numerical arc IDs. The maximum number of arcs in the beach line must be specified in advance.

#### Template Parameters

<i>PolicyT</i>	The algorithm policy to use, instance of <a href="#">Policy</a> template.
----------------	---

#### 3.4.2 Constructor & Destructor Documentation

3.4.2.1 `template<typename PolicyT > frivol::fortune::BeachLine< PolicyT >::BeachLine ( const containers::Array< PointT > & sites, Idx max_arcs )`

Constructs [BeachLine](#).

#### Parameters

<i>sites</i>	The input sites for the algorithm.
<i>max_arcs</i>	The number of arcs the beach line must be able to contain.

### 3.4.3 Member Function Documentation

**3.4.3.1** `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getLeftArc ( Idx arc_id ) const`

Returns the ID of the arc left from given arc.

#### Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

#### Returns

arc ID of the arc to the left from *arc\_id*, or *nil\_idx* if *arc\_id* is the leftmost arc.

**3.4.3.2** `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getMaxArcCount ( ) const`

Gets the maximum number of arcs there can be in the beach line. The arc IDs are in 0, ..., [getMaxArcCount\(\)](#)-1.

**3.4.3.3** `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getOriginSite ( Idx arc_id ) const`

Returns the index of the origin site of given arc.

#### Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

**3.4.3.4** `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getRightArc ( Idx arc_id ) const`

Returns the ID of the arc right from given arc.

#### Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

#### Returns

arc ID of the arc to the right from *arc\_id*, or *nil\_idx* if *arc\_id* is the rightmost arc.

**3.4.3.5** `template<typename PolicyT> std::pair< Idx, Idx > frivol::fortune::BeachLine< PolicyT >::insertArc ( Idx site,  
const CoordT & sweepline_y )`

Adds arc to the right place in the beach line. The arc ending up under the new arc is split in two.

#### Parameters

<i>site</i>	The origin site of the arc.
<i>sweepline_y</i>	The Y-coordinate of the sweep line that defines the parabolas.

#### Returns

pair consisting of the ID of the new arc and the ID of the arc on which it was placed and that was split in two, or *nil\_idx* if the beach line was empty.

## Exceptions

<code>std::logic_error</code>	if the maximum number of arcs ( <a href="#">getMaxArcCount()</a> ) are already in use.
-------------------------------	--

### 3.4.3.6 `template<typename PolicyT > void frivol::fortune::BeachLine< PolicyT >::removeArc ( Idx arc_id )`

Removes arc from the beach line.

## Parameters

<code>arc_id</code>	The ID of the arc to remove.
---------------------	------------------------------

The documentation for this class was generated from the following files:

- `/home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach_line.hpp`
- `/home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach_line_impl.hpp`

## 3.5 `frivol::containers::priority_queues::DummyPriorityQueue< PriorityT >` Class Template Reference

Simple implementation of [PriorityQueueConcept](#).

```
#include <dummy_priority_queue.hpp>
```

## Public Member Functions

- **DummyPriorityQueue** (Idx size)
- `std::pair< Idx, PriorityT > pop ()`
- `bool empty () const`
- `void setPriority (Idx key, PriorityT priority)`
- `void setPriorityNIL (Idx key)`

The documentation for this class was generated from the following files:

- `/home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queues/dummy_priority_queue.hpp`
- `/home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queues/dummy_priority_queue_impl.hpp`

## 3.6 `frivol::containers::search_trees::DummySearchTree< ElementT >` Class Template Reference

Simple implementation of [SearchTreeConcept](#) (a wrapper around `std::list`).

```
#include <dummy_search_tree.hpp>
```

## Public Types

- `typedef std::list< ElementT >::iterator Iterator`

## Public Member Functions

- `template<typename FuncT >`  
Iterator **search** (FuncT func)

The documentation for this class was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/containers/search_trees/dummy_search_tree.hpp`

## 3.7 frivol::GeometryTraits< CoordT > Struct Template Reference

```
#include <geometry_traits.hpp>
```

### 3.7.1 Detailed Description

```
template<typename CoordT>struct frivol::GeometryTraits< CoordT >
```

Traits class that gives needed geometry operations for the algorithm. Implemented traits are required by [Policy](#).

#### Template Parameters

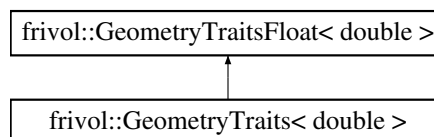
<i>CoordT</i>	The coordinate type to use.
---------------	-----------------------------

The documentation for this struct was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp`

## 3.8 frivol::GeometryTraits< double > Struct Template Reference

Inheritance diagram for frivol::GeometryTraits< double >:



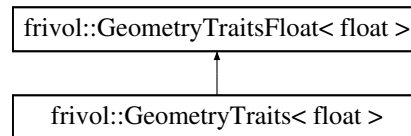
### Additional Inherited Members

The documentation for this struct was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp`

## 3.9 frivol::GeometryTraits< float > Struct Template Reference

Inheritance diagram for frivol::GeometryTraits< float >:



### Additional Inherited Members

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry\_traits.hpp

## 3.10 frivol::GeometryTraitsFloat< CoordT > Struct Template Reference

```
#include <geometry_traits.hpp>
```

### Static Public Member Functions

- static CoordT **getBreakpointX** (const [Point](#)< CoordT > &a, const [Point](#)< CoordT > &b, CoordT topy, bool positive\_big)
- static CoordT **getCircumcircleTopY** (const [Point](#)< CoordT > &a, const [Point](#)< CoordT > &b, const [Point](#)< CoordT > &c)
- static bool **isCCW** (const [Point](#)< CoordT > &a, const [Point](#)< CoordT > &b, const [Point](#)< CoordT > &c)

### Static Public Attributes

- static constexpr CoordT **epsilon** = 1e-30

#### 3.10.1 Detailed Description

```
template<typename CoordT>struct frivol::GeometryTraitsFloat< CoordT >
```

Implementation of [GeometryTraits](#) for floating point coordinate types (float and double).

The documentation for this struct was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry\_traits.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/geometry\_traits\_impl.hpp

## 3.11 frivol::GeometryTraitsImplementedConcept< CoordT > Class Template Reference

```
#include <geometry_traits.hpp>
```

#### 3.11.1 Detailed Description

```
template<typename CoordT>class frivol::GeometryTraitsImplementedConcept< CoordT >
```

Concept for checking that all required [GeometryTraits](#) are implemented for given coordinate type. Required operations are:



- CoordT getBreakpointX( Point<CoordT> a, Point<CoordT> b, CoordT topy, bool positive\_big) returns the X coordinate of intersection of the two parabolas defined by  $(x-a.x)^2 + (y-a.y)^2 = (y-topy)^2 = (x-b.x)^2 + (y-b.y)^2$ . The function may assume that  $a.x \leq b.x$ ,  $a.y \leq topy$  and  $b.y \leq topy$ . The function should choose the solution where the parabola around a goes under the parabola around b. In cases where this does not happen, the result should be very big number, positive if positive\_big, otherwise negative.
- CoordT getCircumcircleTopY(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c) returns the Y coordinate of the top point (i.e. highest Y coordinate) of the circumscribed circle around triangle 'abc'. In case of (almost) collinear points, the result should be very big or very small compared to site coordinates.
- bool isCCW(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c) returns true if triangle 'abc' is oriented counterclockwise.

#### Template Parameters

<i>CoordT</i>	The coordinate type.
---------------	----------------------

The documentation for this class was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry\_traits.hpp

## 3.12 frivol::Point< CoordT > Struct Template Reference

```
#include <point.hpp>
```

### Public Member Functions

- [Point](#) (CoordT x, CoordT y)
  - [Point](#) ()
- Constructs point with undefined values as coordinates.*

### Public Attributes

- CoordT [x](#)
- The X coordinate of the point.*
- CoordT [y](#)
- The Y coordinate of the point.*

#### 3.12.1 Detailed Description

```
template<typename CoordT = double>struct frivol::Point< CoordT >
```

Two-dimensional point.

#### Template Parameters

<i>CoordT</i>	The coordinate type to use. Should be default constructible. Defaults to double, which is the coordinate type of DefaultPolicy.
---------------	---

#### 3.12.2 Constructor & Destructor Documentation

3.12.2.1 `template<typename CoordT = double> frivol::Point< CoordT >::Point ( CoordT x, CoordT y ) [inline]`

Constructs point with given coordinates.

#### Parameters

<code>x</code>	The X coordinate.
<code>y</code>	The Y coordinate.

The documentation for this struct was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/point.hpp`

### 3.13 `frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT >` Struct Template Reference

```
#include <policy.hpp>
```

#### Public Types

- `typedef CoordT Coord`

#### 3.13.1 Detailed Description

`template<typename CoordT, template< typename PriorityT > class EventPriorityQueueT, template< typename ElementT > class BeachLineSearchTreeT>struct frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT >`

[Policy](#) class for the Fortune's algorithm, specifying data types and data structures to use.

#### Template Parameters

<i>CoordT</i>	The coordinate type to use. Should be ordered and default constructible to undefined value. Should have specialization of <a href="#">GeometryTraits</a> .
<i>EventQueueT</i>	The priority queue type for events. Must conform to <code>PriorityQueueConcept</code> .
<i>BeachLineT</i>	The search tree to use for the "beach line" of arcs. Must conform to <code>SearchTreeConcept</code> .

The documentation for this struct was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/policy.hpp`

### 3.14 `frivol::containers::PriorityQueueConcept< X, PriorityT >` Class Template Reference

```
#include <priority_queue_concept.hpp>
```

#### 3.14.1 Detailed Description

`template<typename X, typename PriorityT>class frivol::containers::PriorityQueueConcept< X, PriorityT >`

Concept checking class for priority queues `X` with priority values of type `PriorityT` (or `NIL`). Priority queues are initialized with given size, and contain priority values for keys 0, 1, ..., size-1. Initially, all priority values are `NIL`. `X` must support the following operations:

- `<construct>(Idx size)` creates priority queue for keys 0, 1, ..., size-1.
- `bool empty()` const returns true if all keys have NIL priority.
- `std::pair<Idx, PriorityT> pop()` returns pair of a key with lowest non-NIL priority and its priority and sets the priority to NIL.
- `void setPriority(Idx key, PriorityT priority)` sets the priority value of 'key' to non-NIL value 'priority'.
- `void setPriorityNIL(Idx key)` sets the priority value of key 'key' to NIL.

X may assume that PriorityT is ordered with `<`-operator. X may have undefined behavior if supplied keys are out of range or if `pop()` is called when `empty()` returns true.

The documentation for this class was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queue_concept.hpp`

## 3.15 `frivol::containers::SearchTreeConcept< X, ElementT >` Class Template Reference

```
#include <search_tree_concept.hpp>
```

### Public Types

- `typedef X::Iterator` **IteratorT**

### 3.15.1 Detailed Description

```
template<typename X, typename ElementT>class frivol::containers::SearchTreeConcept< X, ElementT >
```

Concept checking class for search trees X for elements of type ElementT. Search trees are sequence containers, the elements of which are iterated using iterator objects of type X::Iterator. The iterator must be a standard bidirectional iterator. X must support the following operations:

- `<construct>()` creates empty search tree.
- `bool empty()` const returns true if the search tree is empty.
- `Iterator begin()` returns the iterator of the first element (or past-the-end if empty).
- `Iterator end()` returns the iterator past the last element.
- `template<typename FuncT> Iterator search(FuncT func)` searches the sequence using the supplied int(-iterator)-function that for given iterator iter returns negative if the searched element is before iter, positive if it is after iter, and 0 if iter is the right element. If an element such that func returns 0 is found, it is returned, otherwise `end()` is returned.
- `void erase(Iterator iter)` removes element at iter. Other iterators should not be invalidated.
- `Iterators insert(Iterator iter, const ElementT& elem)` inserts elem before iter and returns the iterator of the new element. Does not invalidate any iterators.

X may assume that ElementT is copy constructible.

The documentation for this class was generated from the following file:

- `/home/topi/unison/Asiakirjat/frivol/frivol/containers/search_tree_concept.hpp`

## 3.16 frivol::containers::Stack< T > Class Template Reference

```
#include <stack.hpp>
```

### Public Member Functions

- [Stack](#) ()  
*Constructs empty stack.*
- bool [empty](#) () const  
*Returns true if the stack is empty.*
- T & [top](#) ()
- void [pop](#) ()  
*Removes the top element of the stack. Call only if [empty\(\)](#) is false.*
- void [push](#) (const T &element)

### 3.16.1 Detailed Description

```
template<typename T>class frivol::containers::Stack< T >
```

[Stack](#) of elements.

#### Template Parameters

<i>T</i>	The type of stored elements. Should be default constructible.
----------	---

### 3.16.2 Member Function Documentation

3.16.2.1 `template<typename T> void frivol::containers::Stack< T >::push ( const T & element )`

Pushes element to the top of the stack.

#### Parameters

<i>element</i>	The element to push.
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3.16.2.2 `template<typename T> T & frivol::containers::Stack< T >::top ( )`

Returns reference to the top element of the stack. Call only if [empty\(\)](#) is false.

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/stack.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/containers/stack\_impl.hpp